APPENDIX

Opinion of the United States Court of Appeals for the Second Circuit, Filed March 14, 1968

MOORE, *Circuit Judge*:

The Parties

Plaintiff is the trustee in bankruptcy of Crosby Teletronics, Corp., the sole owner of the patent at issue. Defendant is General Electric Co., Inc., a New York corporation.

The Issue

This is an action for infringement of United States Patent No. 2,851,532 issued to Murray Crosby on September 9, 1958 on an application filed with the Patent Office on April 21, 1953. The patent relates to a method of FM stereo radio transmitting and receiving. Plaintiff alleged that General Electric manufactured and sold FM stereo receiving, transmitting, and adapting equipment using devices and methods embodied in Crosby's patented invention. Defendant waived the defense of non-infringement by pretrial stipulation. Thus, the only defense before the trial court, and now before us, was patent invalidity. The trial court found the patent valid. We reverse on the ground that Crosby's invention would have been obvious at the time of invention to a person of ordinary skill in the radio art. *35 U. S. C. §103.* As the Supreme Court has directed, we focus on several factual inquiries:

> " . . . [T]he scope and content of the prior are are to be determined; differences between the prior art and the claims at issue are to be ascertained; and

the level of ordinary skill in the pertinent art resolved. . . . "

Graham v. *Deere Co. of Kansas City* 383 U. S. 1, 17 (1966).

The Patent at Issue

Stereophonic sound is now familiar to all music listeners. In substance, two microphones record the performance, one from each side of the stage. The music is reproduced through two speakers spaced some distance apart—the left-hand speaker reproducing what has been picked up by the left-hand microphone, the right-hand speaker that which has been picked up by the right-hand microphone. This use of separate left (L) and right (R) channels makes the music produced at any particular point on the concert stage appear to emanate from a corresponding point in the listener's living room, creating a spatial or depth illusion—the live quality of the music.

Crosby taught a technique for full fidelity FM [1] stereo radio which was monophonically compatible. This means that while the listener with the stereo receiver hears the L channel from one speaker and the R channel from the other, the listener with only a monaural (non-stereo) receiver hears a balanced mixture of the two channels—the same

[1] There are two ways to transmit sound by a radio carrier wave. Either the amplitude is modulated (AM) or the frequency is modulated (FM). The technique used often describes the radio system, i.e., AM radio and FM radio. At the time of invention, AM radio offered better prospects for commercial gain than did FM radio. However, by using FM, Crosby was able to transmit the full audio range of 20 to 15,000 cycles per second, thus providing a full fidelity sound. The FCC permitted this broad band transmission on FM; it did not permit it on AM, for it wanted to "stuff" more stations into the available area. Thus, AM radio is not considered to be full fidelity.

sound he would hear if the program were being broadcast monophonically. Without this compatibility, the monaural listener would hear only one channel (either L or R), with its unbalanced emphasis on the music being produced on only one side of the stage.

Crosby achieved this compatibility by the use of a sum-and-difference matrixing, which he believed he had invented. This method electronically combines (matrixes) the L and R channels in such a way as to produce two new signals, the (L + R) signal and the (L — R) signal. The (L + R) signal is then broadcast in the usual fashion. The (L — R) signal is broadcast over a subcarrier superimposed on the same carrier wave. This is termed "subcarrier" multiplexing.[2] If the receiver is monaural, it only reproduces the (L + R) signal. However, in a stereophonic receiver the (L — R) signal on the subcarrier is also used. The two signals are put through a matrix, providing for the L signal for the left speaker and the R signal for the right speaker.[3]

An advantage of the sum-and-difference matrixing as used by Crosby is that it equalized the signal/noise ratio of the left and right channels. A certain volume of noise is inherent in all radio transmission; this can be particularly distracting where, as in non-matrix stereo systems, different amounts of noise can be heard in the two speakers.

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[2] Our result does not require a more accurate, and necessarily more technical, explanation of "subcarrier" multiplexing. Equally simplified, there are two other ways of sending two or more radio signals over the same carrier wave. The "hybrid" style of multiplexing provides for modulating the amplitude of one signal and the frequency of the other. The "switching" method provides for high speed changing of the two signals on the carrier wave.

[3] In the dematrixing process, the two signals are added and subtracted. Algebra dictates that (L + R) + (L — R) = 2L and that (L + R) — (L — R) = 2R.

Crosby's invention balanced the noise. Furthermore, although it was not initially emphasized, the Crosby patent resulted in complete separation of channels over the full audio range. Only the L channel would be heard from the left-hand speaker, only the R channel from the other. Other systems, which, to conserve band width, as was certainly necessary in the AM field (e.g., the Boelens patent), restricted the audio range of one of the signals, yielded a mixed or monophonic sound over the audio range in which only one channel was broadcast. For example, if (L + R) was broadcast with an audio range of from 0 to 15,000 and if (L — R) was broadcast with an audio range of from only 0 to 5,000, then the channels would be separate from 0-5,000; from 5,000 to 15,000 (L + R) would be heard from both speakers.[4]

Scope and Content of the Prior Art

Implicit in the trial judge's opinion and findings of fact and law is the scope of the prior art—the field of radio communication. In establishing the content of this area, defendant introduced a number of patents. To constitute

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[4] Crosby, re-direct examination, transcript page 652:

> "If it so happened that the frequency response of the (A — B) was not carried out to the same full range as the sum combination (A + B), this algebra just wouldn't work out. * * * [It] would become a combination which would be 2A [on one speaker] up to a certain cutoff frequency at where the frequencies fed to the subcarrier * * * were artificially cutoff, * * * so that you would have (A + B) * * * plus (A — B) equals 2A up to this cutoff frequency range, which we might say was * * * five kilocycles, and then for the range from five to fifteen kilocycles you would have (A + B), which would be a monophonic reproduction, because it would be be (A + B) in both loud speakers in the range from five kilocycles to fifteen kilocycles, assuming a cutoff frequency of five kilocycles. In other words, this algebra just wouldn't function under these circumstances."

prior art, they must teach the invention with clarity and explicitness. *Technical Tape Corp.* v. *Minnesota Mining & Mfg. Co.*, 143 F. Supp. 429, 435-36 (S. D. N. Y. 1956), *aff'd* 247 F. 2d 343 (2 Cir. 1957). We need to discuss only three of the patents offered in evidence. The trial judge found their teachings clear enough for us to rely on them.

The German Patent No. 861,884 to Griese, applied for in 1950 and issued in 1953, taught a "subcarrier" type of multiplexing for FM stereo radio. No matrixing was used, however, and therefore there was no compatibility. By 1953, this "subcarrier" method was standard for transmitting two FM signals over the same radio wave. The British Patent No. 540,185 issued in 1941 to Standard Telephones & Cables, Ltd. It taught the sum-and-difference matrixing to provide for monophonic compatibility in standard narrow channel AM broadcasting. Since the patent was for the AM field, the band widths were restricted, thereby providing less than full fidelity. However, the audio ranges transmitted over the two channels were equal. A "hybrid" style multiplexing was used. The United States Patent No. 2,698,379, based on a Netherlands parent application filed in 1951, issued to Boelens in 1954. Similar to the Standard Telephones patent, its teachings are more pertinent and comprehensive. Among other things, it taught the same matrix circuitry that would later be used in the Crosby patent. However, as with other AM patents, it restricted the frequency range on the second channel,[5] naturally resulting [see fns. 1, 4 and 8] in less

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[5] Oral Argument on Appeal, Transcript page 7:

> Mr. Chapin [Crosby's attorney]: Also, Boelens did not teach the use of substantially full audio frequency. Boelens, as a matter of fact, taught very clearly that you cut off the low 300 cycles per second and you attenuate above something like 4000.
>
> Judge Friendly: Why did he do that?
>
> Mr. Chapin: Because he was trying to narrow the band width.

than full fidelity, an unbalanced signal noise ratio, and incomplete separation of signals.

Level of Ordinary Skill

35 U. S. C. §103 provides for a specialized reasonable man test for obviousness. In our case, this reasonable man follows *a fortiori* from the definition of the scope of the prior art; he is the man with ordinary skill in radio communication. Thus, our question: what would have been obvious to a reasonable radio engineer who, among other things, had the Griese, Standard Telephones, and Boelens patents in mind when he endeavored to solve the problem of how to achieve monophonic compatibility on FM stereo radio? *Formal Fashions, Inc.* v. *Braiman Bows, Inc.*, 369 F. 2d 536 (2 Cir. 1966).

Patent Validity

The trial judge found the invention nonobvious. We are aware of the dangers of slipping into the use of hindsight and of reading into the prior art the teachings of the invention. *Graham* v. *John Deere Co., supra* at 36. Nevertheless, the question of patentability is one of law. *Graham* v. *John Deere Co., supra* at 17; *Great Atlantic & Pacific Tea Co.* v. *Supermarket Equipment Corp.*, 340 U. S. 147, 155 (1940). We have considered the Patent Office's determination, *Ling-Temco-Vought, Inc.* v. *Kollsman Instrument Corp.*, 372 F. 2d 263, 268 (2 Cir. 1967) and the trial judge's conclusion. Nevertheless, we find that the invention would have been evident to an engineer of ordinary skill in the radio field in 1953.

The trial judge placed great emphasis on the secondary, supporting issues. He did not focus on the inventive process so much as the after-the-discovery results and oc-

currences. He concluded that Crosby's *results* filled a *real need* in the industry. He bolstered this finding by emphasizing the *acclaim* accorded Crosby and the resultant *commercial success* of his invention. Although the issues the trial judge relied on may be appropriate for consideration, *Ling-Temco-Vought, Inc.* v. *Kollsman Instrument Corp., supra* at 269, they are not to carry too heavy a burden. *Graham* v. *John Deere Co., supra* at 29-30, 36. We place primary reliance on the technical facts of the inventive process; we think that the secondary issues relied on by the trial judge to reach an opposite conclusion either support our determination or are simply inconclusive.

(I)

Even if the problem which the trial judge thought Crosby had solved—how to achieve monophonically compatible stereo FM radio with full separation over the full audio range—was the problem [see part III] the industry needed solved [see part II], Crosby's combination of known radio features would have been obvious to a skilled radio engineer in 1953. Crosby merely updated and upgraded the presently existing FM stereo system by adding the already developed (although he did not know it) AM sum-and-difference matrixing. Little more was needed.

First, however, Crosby's claims of full separation over the entire audio range and a balanced signal/noise ratio, both collateral results, should not be allowed to distract us from the principal aspect of the problem which Crosby was trying to solve—how to achieve compatibility.[6] All

[6] Mr. Kassens, Transcript of "Evolution of a Hi Fi Broadcast," *FM Music Program Guide*, 12, 32 (October, 1966):

> "I think he [Crosby] did an amazing amount of work to get this thing down the right track. If I am not mistaken it was he who first came up with the idea of matrixing the left and right channel. *This of course made for a compatible system, which was our principal concern.*" (Emphasis added.)

agreed that if he solved this problem in the FM field, and if full and equal signals were broadcast over both channels, which would have been probable if there were no FCC restrictions, as in AM, then it was mathematically obvious that there would be full separation over the entire audio range.[7] A balanced signal/noise ratio also inhered in his solution.[8] If there was, as there was here, an obvious reason for solving the principal feature of a problem, e.g., monophonic compatibility on FM stereo, the doing of it does not become nonobvious because incidental values inhered in the solution. *General Electric Co.* v. *Jewel Incandescent Lamp Co.*, 326 U. S. 242 (1945). This is surely true if the values had been recognized, but were considered to be incidental.

It is clear that monophonic compatible radio was as desirable in the FM sphere as it was in the AM sphere.

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[7] Crosby's testimony [see fn. 4] indicates that complete separation over the full audio range is a simple function of having equal frequency ranges on the two channels. If there is no cut-off on one of the channels, the algebra just works out to create full separation. The British Patent to Standard Telephones had equal frequency ranges on both of its channels, although both were restricted ranges so as to comply with AM regulations.

[8] Feldman [plaintiff's expert], cross-examination, transcript pages 1024-25:

> Q. And is it fair to say as a layman's expression of this that in the course of unscrambling the sum and difference signals, you scramble the noise of the two channels? A. That's a very good way of putting it, yes. You scramble it or in some way average out, I prefer to use that term.
>
> Q. Am I correct in understanding that in these sum and difference systems where that takes place the effect on the two channels that have different efficiencies with respect to noise is that the better channel gets degraded somewhat in the course of being equalized with the poorer channel? A. That's correct.

There were monaural FM listeners, just as there were monaural AM listeners. Neither wanted an unbalanced sound. It would have been perfectly natural for someone who was aware of the AM sum-and-difference matrixing to plug it into the existing FM stereo system. And although Crosby did not know of the Standard Telephones and the Boelens patents in 1953, this appears to be exactly what he did.

The Griese style of "subcarrier" multiplexing was known to Crosby as the type commonly used on FM stereo in 1953. Crosby changed nothing in it by adding a matrix system. And the matrix Crosby added used circuit designs identical to those used in the Boelens patent. The AM designs required no change to accommodate the wider audio range of the FM world. At trial, Crosby admitted that he had done no more than add the matrix to the FM system.[9] This is classically nonpatentable. An old method was merely ". . . applied to a new and closely analogous subject matter, plainly indicated by the prior art . . ." *Paramount Publix Corp.* v. *American Tri-Ergon Corp.*, 294 U. S. 464, 473 (1935). There was no technology gap in producing monophonically compatible stereo radio; rather, as will be shown, there was a gap of interest and motivation.

(II)

Prior to the 1950's, there had been some work in stereo radio. The record includes a number of the developments.

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[9] Crosby on Cross-Examination, Transcript page 372:

> Q. And am I correct in saying that as you knew the art at the time, the prior knowledge, you simply took the going FM multiplex system and added at the transmitter this matrix to accomplish the addition and subtraction, and that you added at the receiver the matrix for doing the addition operation and the subtraction operation that yield A and B separately? A. Yes.

In 1924, United States Patent No. 1,513,973 was issued to Doolittle. It taught stereophonic broadcasting using two separate radio channels. In 1937, a patent issued to Electric and Musical Industries, Limited. It discussed the possible use of the sum-and-difference technique of a single channel. The British Patent to Standard Telephones issued in 1941. And in 1943, the parent application of the Weyers patent issued in the Netherlands. On a practical level, as early as 1933, Leopold Stokowski transmitted a concert from Philadelphia to Washington in stereo.

Against this background, and an additional flurry of professional activity in the early 1950's, Crosby applied for his patent. In 1958 it issued. However, it was not until 1961 that the FCC approved FM stereo broadcasting on a commercial scale. And then the FCC adopted the Zenith-General Electric 4-4-a system rather than Crosby's. *Inter alia,* the 4-4-a not only achieved compatible, full fidelity FM stereo, but, unlike Crosby's, it also conserved sufficient space to permit stations to broadcast a profitable SCA (e.g., uninterrupted background music service) subcarrier along with a stereo program.

The trial judge found that this history indicated a "desire" for FM stereo. He then drew the inference that since Crosby satisfied the desire, the invention must have been nonobvious. As he said: "He [Crosby] was confronted with the same obstacles and problems of FM stereo as were others devoted to the art. However, his ingenuity and efforts solved the problem." We find that the record does not support this inference. Many researchers had simply ignored the field.

In the first place, the FCC regulates the radio communication industry. Without its approval, no radio system can be profitable. For example, FM stereo was not approved until eight years after Crosby disclosed his invention. There was therefore little incentive for researchers to devote their laboratories to this area of uncertain return. In the second place, public interest did not become apparent until the mid-1950's. The development of the stereo disc in 1957 was the catalyst for this interest. And as a result, some large radio producers increased their research efforts in the area of FM stereo. For example, it was in 1957 that General Electric first evinced concern for the new area.

Thus, although there might have been a professional desire for FM stereo radio in 1953, neither the FCC nor the public had been sufficiently excited so as to generate an active interest in some of the larger research laboratories. Crosby ventured forth almost alone; as he said, ". . . [others] got in the act after I had sort of drawn their attention to the use of multiplex for stereo." Transcript of "Evolution of a Hi Fi Broadcast," *FM Music Program Guide,* 12, 32 (October, 1966). Crosby did not fill an existing need, for there was none, with his invention; rather, after inventing the system, he sought to promote a need for it. He had to sell his product to the FCC and then to the public. It is to his credit that he would work in an area of such uncertain profit, *United States* v. *Adams,* 383 U. S. 39, 52 (1966), but such a fact does not support the conclusion that he filled a need in the industry from which to draw an inference that his invention must have been nonobvious.

(III)

Moreover, even if some inference as to nonobviousness could be drawn from the history of the industry, the evidence does not support the contention that the "insoluble" problem facing the professionals was how to achieve compatible FM stereo with full separation. All agreed that full separation follows naturally if equal frequency ranges are maintained on both channels. It is a mathematical fact, and it was obviously desirable *if* nothing else had to be sacrificed. However, to achieve full separation, other things would have to be given up. For example, it was evident that if equal audio ranges were to be broadcast over both channels, the cost of the radio would be higher than if one channel had a restricted signal. The principal "insoluble" problem was how to achieve monophonic compatibility and still keep the band widths narrow enough to accommodate other FM services, such as SCA. For instance, Weyers, who was issued United States Patent No. 2,515,619 in 1950, was principally concerned with conserving band width; he therefore cut off the frequency range on the second channel, thereby losing the advantage of full separation. As counsel admitted in oral argument, most of those involved in this type of research were principally concerned with the problem of narrow band width.[10] Crosby ignored this aspect of the problem altogether.

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[10] Oral Argument on Appeal, Transcript page 57:

> Judge Friendly: I want to be sure I have your full point as to the importance of recommending this full frequency on the subcarrier. Why was it that people had not been doing that at least on FM?
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> Mr. Chapin: Again, your honor, this was a matter of band widths.
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> Judge Friendly: Even in FM?
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> Mr. Chapin: Yes. They were trying to save room for some of those ancillary services, and . . .

In finding the problem to be solved that of monophonic compatibility and full separation, the trial judge relied on the fact that the FCC rejected other systems which did not provide for this full separation. However, the FCC also rejected Crosby's system, for it did not leave band width space for the SCA broadcasts. The 4-4-a system, which provided both, was chosen.

Support for our conclusion that Crosby solved only a truncated problem is found in the fact that Crosby never emphasized full separation in his patent. In 1957 he amended his claim to distinguish it from the Boelens patent by asserting that his system offered full frequency over both channels. There was no emphasis on equality between the channels, and this is the key to full separation. Thus, there is the inference that Crosby too viewed full separation not as a solution to a problem, but rather as a value incidental to his principal solution of compatibility. The belated emphasis on this feature of his combination indicates that it is merely an afterthought. *Graham* v. *John Deere Co., supra* at 25. Plaintiff has defined the problem facing the industry by the solution invented. No inference of his ingenuity in solving the complete problem is supportable.

(IV)

Admittedly, there was considerable professional excitement over Crosby's invention. The radio industry acclaimed his discovery. But this was because he was the first to make the addition he did, not because his invention was nonobvious at the time. Moreover, for every speech and audience, there must be a speaker. And in this case, part of the enthusiasm was generated by the inventor.[11]

[11] Crosby, Cross-Examination, Transcript page 543:

Q. Now, may I turn to another subject, Mr. Crosby. I recall to you, without attempting how to summarize it at all, your tes-

(footnote continued on next page)

To make his invention commercially profitable, Crosby had to convince the public and the FCC that it was desirable. Therefore, as Crosby admitted, he promoted his product. Transcript of "Evolution of a Hi Fi Broadcast," *supra* at 32. Under such circumstances, the trial judge relied too heavily on this after-the-discovery acclaim to support the inference of nonobviousness at the time of invention.

(V)

The evidence is conflicting as to commercial success. For example, although thirty companies took licenses from Crosby, many of them were small. It is possible that they acquiesced merely to avoid the problems, and cost, of fighting a law suit. A number of very large companies did not take licenses. However, even if there were conclusive evidence of commercial success, nothing more can be concluded than that Crosby's invention has proven useful and saleable. We cannot here draw the inference of nonobviousness. *Graham* v. *John Deere Co., supra* at 36.

Reversed.

(footnote continued from previous page)

timony concerning various talks which you gave in the period from 1953 to the late 1950's to various groups, and your testimony in relating to that concerning the publication of two papers which are exhibits.

Now, in relation to that period and to that general subject, could you agree that you were at that time deliberately attempting to promote interest in your particular stereo FM system as it was described in the two papers which you delivered at meetings? A. Well, in the beginning it was merely the presentation of an engineering paper in a manner that I have done on many occasions, and have written many articles in the technical journals. But as time went on, it became a promotion whether I liked it or not, because of the opposition that appeared.

Judgment, Entered March 14, 1968

UNITED STATES COURT OF APPEALS

FOR THE

SECOND CIRCUIT

At a Stated Term of the United States Court of Appeals, in and for the Second Circuit, held at the United States Courthouse in the City of New York, on the fourteenth day of March one thousand nine hundred and sixty-eight.

Present:

Hon. J. EDWARD LUMBARD,
Chief Judge,

HON. LEONARD P. MOORE,
HON. HENRY J. FRIENDLY,
Circuit Judges.

M. RUDOLPH PREUSS, Trustee in Bankruptcy of CROSBY-TELETRONICS CORP.,

Plaintiff-Appellee,

v.

GENERAL ELECTRIC CO., INC.,

Defendant-Appellant.

Appeal from the United States District Court for the Eastern District of New York,

This cause came on to be heard on the transcript of record from the United States District Court for the Eastern District of New York, and was argued by counsel.

Opinion of the United States District Court

ON CONSIDERATION WHEREOF, it is now hereby ordered, adjudged, and decreed that the judgment of said District Court be and it hereby is reversed in accordance with the opinion of this court with costs to the appellant.

A. DANIEL FUSARO
Clerk

UNITED STATES COURT OF APPEALS

SECOND CIRCUIT

Filed
Mar 14 1968

A. DANIEL FUSARO, Clerk

Opinion of the United States District Court for the Eastern District of New York, Filed May 3, 1967

BRUCHHAUSEN, D. J.

This is an action for infringement of a patent. The application therefor was filed in the Patent Office by Mr. Murray G. Crosby on April 21, 1953 and granted under Patent No. 2,851,532 on September 9, 1958. The claims relied upon are numbered 10, 12, 16, 18, 22, 24 and 25. Claims numbered 12, 16 and 24 relate to receiving equipment. Claims numbered 10, 18 and 22 allude to transmitting equipment and claim number 25 pertains to equipment for the adapting of a monophonic receiver, producing stereophonic signals in a stereo manner. The defense is invalidity of the patent.

Between the period of his graduation as an electrical engineer, in or about the year 1925, and the spring of 1953, when he filed his application for the subject patent, Mr. Crosby devoted his talents to the electronic communications field, specializing in FM communications. In the first nineteen years of that period, he was employed by the Radio Corporation of America at its receiving station for transocean communications. He assigned a number of patents to the said corporation. Thereafter, he continued the same type of endeavor with several other concerns and in 1948 organized his own company. Early in 1951, his company entered into an eighteen months contract with the United States Naval Department to devise an FM Multiplex System for a special one-way disaster type of communication. He testified that this occupation immersed him and his associates in considerable multiplex research and thinking on the subject matter of the patent in suit (R. 304-310). Mr. Crosby then conducted numerous experiments, with the object of producing practical equipment, acceptable to the industry. He eventually devised a system, which he named "Multiplex Communication System", culminating in the subject patent. His invention relates to a multiplex communication system and more particularly to the binaural transmission and reception of sound. He was aware of the contribution to the art, made by Major Armstrong, set forth in his 1933 patent, teaching the advantages of wide-band FM radio broadcasting.

On June 15, 1953, a few months after he filed his application for the subject patent, he was invited to address the American Institute of Electrical Engineers. His subject was "Binaural Sound on One FM Channel" (R. 314; Exh. 29).

That presentation comprised the results of the measurement of the material, recorded from his experiments (R. 316).

Exhibit 29 includes, in substance, the disclosure in the subject patent application.

In December 1953, Mr. Crosby was invited to address the Institute of Radio Engineers on the same subject (R. 317).

During that year, he gave demonstrations illustrating his new broadcasting technique to a Sylvania engineer, as well as to a large assemblage of representatives of the National Broadcasting Company and Radio Corporation of America, including Mr. Charles Dennings, a former chairman of the Federal Communications Commission and then a vice-president of National Broadcasting Company (R. 319).

On October 11, 1957, by invitation, Mr. Crosby addressed the Audio Engineering Society on the subject entitled "A Compatible System of Stereo Transmission by FM Multiplex" (R. 323).

Under date of October 25, 1957 Mr. Jerry A. Meyer, an employee of the defendant's Radio Receiver Department, wrote Mr. Crosby for a copy of the aforesaid address, and he also sent a copy of his letter to Mr. W. H. Beaubien, another employee of the defendant.

Mr. Meyer therein stated:

> "We are interested in obtaining a copy of the paper you presented at the Convention (alluding to the said Audio Engineering Society) and any other

information which you feel would help us gain a background in FM multiplexing."

On October 31, 1957, Mr. Crosby sent him a copy of the address (Exh. 30).

In the summer of 1958, the first broadcast under Mr. Crosby's system ensued (R. 330).

During the years 1958 to 1961, Mr. Crosby was invited by engineering societies throughout the United States and in Canada to demonstrate his multiplex system and he complied.

In October 1966, he received an award, set up by The Bell Telephone Laboratories, to the individuals, contributing in the field of telecommunications. A committee, selected by the Institute of Electrical and Electronic Engineers, recommended this award.

The citation mentioned that it was "for his pioneering work in the circuit technology, propagation characteristics and noise suppression of frequency and phase modulation".

These invitations from experts and the demonstrations are some evidence that Mr. Crosby had produced a system, not then obvious to them.

Characteristics of the subject patent not found in the prior arts, are:

1. Monophonic compatability. The system provides for stereophonic transmission and reception together with balanced and undistorted reception by the monophonic receiver;

2. Balanced noise. A main problem in FM stereo broadcasting is that one of the transmitting channels is noisier

than the other. The system in suit overcame this noise in balance by equalizing the noise output in both channels;

3. High Fidelity with complete separation at all frequencies. The system gives the listener full frequency range without any cut-offs and thus provides the listener with the benefits he would receive if he were present at the live broadcast. It also provides for complete stereo separation in both channels;

4. Bandwidth. It achieved the above within the bandwidth rules of the Federal Communication Commission.

The defendant challenges the sufficiency of the patent upon the ground of want of invention in view of the prior art and of what was common knowledge to those skilled in the art, prior to the date of the alleged invention.

Section 35 U. S. C. 282, one of the sections of the Patent Act of 1952, provides that "a patent shall be presumed valid. The burden of establishing invalidity of a patent rests on a party asserting it". The burden upon a defendant, seeking to invalidate a patent for want of novelty, is very heavy. "Every reasonable doubt should be resolved against him." Radio Corporation of America v. Radio Engineering Laboratories, Inc., 293 U. S. 1; Mumm v. Decker & Sons, 301 U. S. 168; Georgia-Pacific Corp. v. United States Plywood Corp., 258 F. 2d 124, 132.

The defense introduced evidence of prior art, thereby attempting to establish that the system devised by Crosby was old, and, therefore, obvious to those skilled in the art. The prior art indicates knowledge of the elements, combined in the Crosby system. However, those so skilled were unable to combine the elements as did Crosby in his single electronic system. He was confronted with the same

obstacles and problems of FM stereo as were others, devoting attention to the art. However, his ingenuity and efforts solved these problems. As stated, when he publicly demonstrated his system, he was acclaimed by those engaged in the art. Some twenty years had then elapsed since Major Armstrong opened the field of FM broadcasting and no one in the art appeared capable of producing the system, now under attack during those two decades. It is apparent that the idea was not obvious, but novel. A real need for transmission and reception of FM stereo was fulfilled by the Crosby patent.

The applicable rule as stated in Great Atlantic & Pacific Tea Co. v. Supermarket Equipment Corp., 340 U. S. 147, at page 151, is:

> "The mere aggregation of a number of old parts or elements which, in the aggregation, perform or produce no new or different function or operation than that theretofore performed or produced by them, is not patentable invention."

The Court further stated, at page 152:

> "The conjunction or concert of known elements must contribute something; only when the whole in some way exceeds the sum of its parts is the accumulation of old devices patentable. Elements may, of course, especially in chemistry or electronics, take on some new quality or function from being brought into concert, but this is not a usual result of uniting elements old in mechanics."

Although those skilled in the art were experimenting in the field of communications, no one other than Crosby assembled or produced a system such as the one now

under attack. As stated by Judge Learned Hand in B. G. Corporation v. Walter Kidde & Co., Inc., 2 Cir., 79 F. 2d 20, the act of selecting materials and assembling them in such a manner, proving serviceable to a given need may require a high degree of originality. It is the act of selection which is the invention, and it must be beyond the capacity of common-place imagination. See, also, Van Heusen Products, Inc. v. Earl & Wilson, 300 Fed. 922; Lyon v. Bausch & Lomb Optical Co., 224 F. 2d 530. Mr. Crosby produced results never before achieved.

The commercial success must also be viewed in the light of the long-continued public acquiescence in the validity of the patent. The advent of FM stereo was responsible for creating many license agreements and the sale of the necessary equipment. Such commercial success is an important factor. Technical Tape Corp. v. Minnesota Mining & Manufacturing Co., 2 Cir., 1957, 247 F. 2d 343; cert. den. 355 U. S. 952.

The Court upon reviewing the voluminous record, the exhibits, briefs and applicable law concludes that the credible evidence clearly establishes that the Crosby system is a new and useful product, within the meaning of the statutes and authorities and that the patent is valid.

Settle findings and decree on notice, on or before May 25, 1967.

WALTER BRUCHHAUSEN,
U. S. D. J.

Findings and Conclusions of the United States District Court for the Eastern District of New York, Filed June 6, 1967

Findings of Fact

The Nature of the Action and the Pleadings

1. This is an infringement action under the patent laws of the United States for infringement of U.S. Letters Patent No. 2,851,532, issued September 9, 1958 to Murray G. Grosby on an application filed April 21, 1953. Plaintiff relies on claims 10, 12, 16, 18, 22, 24 and 25.

2. The complaint was filed on September 15, 1964. The answer was filed on November 2, 1964.

3. The complaint charges General Electric Co., Inc. (G.E.) with infringing the patent in suit by making, selling and using devices embodying the patented invention.

4. The answer asserts the defenses of non-infringement and invalidity. Non-infringement is not now urged by the defendant having been waived by defendant by stipulation before trial. (R. 7-9) As to the invalidity defense, the only issue tried and brief are whether or not the prior art renders the Crosby 2,851,532 patent in suit invalid.

5. During the course of trial, defendant introduced into evidence and took testimony concerning the following eleven items of prior art:

> United States Patent No. 2,233,183 issued to Roder on February 25, 1941 on an application filed November 12, 1938. (DX-A, tab 6)
>
> United States Patent No. 2,515,619 issued to Weyers on July 18, 1950 and based on a Nether-

lands parent application filed April 21, 1943. (DX-A, tab 5)

German Patent No. 861,884 issued to Griese on January 8, 1953. (DX-A, tab 7)

United States Patent No. 2,709,254 issued to Halstead on May 24, 1955 on an application dated August 14, 1950. (DX-A, tab 4)

United States Patent No. 2,698,379 issued to Boelens on December 28, 1954 and based on a Netherlands parent application filed April 28, 1951. (DX-A, tab 3)

British Patent No. 540,185 issued to Standard Telephones and Cables, Ltd. on October 8, 1941 and based on a French patent filed June 30, 1939. Defendant has also cited the Material Telephonique French Patent No. 860,672 which was filed on June 30, 1939 and is the parent application for the Standard Telephones British patent. (DX-A, tabs 1 and 2)

United States Patent No. 2,093,540 issued to Blumlein on September 21, 1937 and based on a British application filed December 14, 1931. (DX-W)

German Patent No. 819,548 issued to Egerer on November 5, 1951. (DX-A, tab 9)

The Altman and Dyer article Multiplex Broadcasting published in the April 1947 issue of ELECTRICAL ENGINEERING. (DX-A, tab 10)

The Landon article, Theoretical Analysis of Various Systems of Multiplex Transmission, pub-

lished in two parts in the June 1948 and September 1948 issue of the RCA REVIEW. (DX-T)

6. In its briefs, defendant relied upon three of the above items of prior art, namely the German patent to Griese, the British patent to Standard Telephones and Cables, Ltd., and the German patent to Egerer.

The Parties

7. Plaintiff is the Trustee in Bankruptcy of Crosby Teletronics Corp. This Trustee was duly appointed by this Court on July 23, 1962. Plaintiff is the sole owner of all right, title and interest in the patent in suit (R. 125-6).

8. Defendant, G.E., is a New York corporation. It is a manufacturer of stereophonic frequency modulation (FM) radio receivers and adapters and a manufacturer and user of stereophonic FM radio transmitter equipment. (R. 6-7)

The Accused Devices (Identification)

9. The accused stereophonic radio receivers made by G.E. have a great many letter and numeral combination designations all of which are represented by the equipment designated T-1000 and T-1005 (PX-5, 6; R. 12-3).

10. The accused stereophonic radio adapters made by G.E. include the designations MA-2F and MA-100 (R. 13).

11. The accused stereophonic radio transmitters made and used by G.E. includes the equipment at station WGY located at Schenectady, New York (PX-7; R. 13-4).

Findings of Fact and Conclusions of Law

The 2,851,532 Patent in Suit

12. Murray Crosby invented and taught a technique for the successful transmission and reception of a stereophonic program on an established FM broadcast band as allocated by the Federal Communications Commission (FCC). This invention constitutes a very significant advance in the radio art which made feasible commercial stereophonic broadcasting and thus opened up a new dimension in this art. This invention provides the means for broadcasting and receiving stereophonic signals whereby the listening public may hear a program which is comparable in realism to what they would hear if they were present in the auditorium or studio where the program originates listening to the program "live".

13. The basic arrangement of the system of FM stereo broadcasting and reception invented and taught by Mr. Crosby is:

(a) That, at the transmitter, the A program signal and the B program signal[1] are matrixed to provide an (A + B) signal and an (A — B) signal;

(b) That this matrixing employ the full audio frequency range of both the A program signal and the B program signal and provide the full audio frequency range of both the (A + B) and (A — B) signals;

(c) That the full audio frequency (A — B) signal is modulated onto a super-audible subcarrier frequency;

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[1] The A program signal is derived by placing a microphone on one side of the stage or studio and the B program signal is derived by placing another microphone on the other side of the stage or studio.

(d) That the full audio frequency (A + B) signal and the modulated subcarrier is frequency modulated onto a radio carrier wave;

(e) That, at the receiver, the (A + B) and (A — B) signals are recovered from the received radio carrier wave over their full audio frequency range;

(f) That the recovered (A + B) and (A — B) signals are dematrixed so as to provide an A signal over its full audio frequency range and a B signal over its full audio frequency range.

(g) That the dematrixing take place in such a fashion that the A signal and B signal are separated, that is, the A signal provided has no substantial component of B signal and that the B signal provided has no substantial component of A signal; and

(h) That the A signal, unmixed with any B signal, is reproduced through one loudspeaker and that the B signal, unmixed with any A signal, is reproduced over the other loudspeaker.

14. A system having the arrangement set forth in Finding 13 was disclosed in the Crosby 2,851,532 patent in suit.

15. The claims in litigation are directed to the system arrangement set forth in Finding 13. For example, claim 10, directed to the transmitting apparatus, and claim 12, directed to the receiving apparatus read as follows:

> Claim 10. Apparatus for improving the signal-to-noise ratio in the binaural transmission of sound on two channels, said apparatus comprising
>
> two sound sources,

means to add the outputs of said sound sources to obtain a summation signal,

means to subtract the said outputs to obtain a subtraction signal,

a superaudible subcarrier generator,

means to modulate the superaudible subcarrier over substantially the full frequency range of the subtraction signal,

means to combine the modulated subcarrier with substantially the full frequency range of the summation signal,

a carrier generator,

means to frequency modulate the carrier by means of the combined signal, and

means to transmit the resulting modulated carrier,

the arrangement being such that the subcarrier as well as the carrier is modulated over so much of the full frequency range of the audio signals carried thereby that a substantial improvement in signal-to-noise ratio is obtained. (PX-41).

Claim 12. Apparatus for improving the signal-to-noise ratio in the binaural reception of sound transmitted on a frequency modulation carrier and a superaudible subcarrier,

said carrier and subcarrier being modulated by substantially the full frequency range of two audio signals carried thereby,

said receiver apparatus including

a frequency modulation detector to demodulate the carrier to obtain the modulated subcarrier and substantially the full frequency range of the carrier audio signal,

means to separate the subcarrier with its signal from the carrier audio signal,

means to demodulate the subcarrier to obtain substantially the full frequency range of the subcarrier audio signal,

means to add the carrier and subcarrier audio signals to obtain a signal A,

means to subtract the said audio signals to obtain a signal B,

spaced reproducers, and

means to supply said signals A and B to said spaced reproducers,

the arrangement being such that the carrier and subcarrier audio signals are reproduced over so much of their full audio frequency range that a substantial improvement in signal-to-noise ratio is obtained. (PX-45).

16. No system having the arrangement set forth in Finding 13 was known prior to Mr. Crosby's teaching.

17. The above system arrangement taught by Mr. Crosby, which in capsule can be said to involve the combining of the appropriate matrixing and dematrixing technique over the full audio frequency range of the signals being processed in the context of a superaudible subcarrier

multiplex transmission technique, provides the realization of the following performance characteristics:

(a) *Monophonic Compatability*—The Crosby system provides for stereophonic transmission and reception of a program, while at the same time providing complete, balanced and undistorted reception of the same program by the monophonic receiver. The Crosby system provides the stereophonic listener with the A program content from one loudspeaker and the B program content from a second loudspeaker, thus creating a realistic stereo illusion simulating "live" listening. At the same time Mr. Crosby's system provides the monophonic listener with the combined content of the A program and B program from a single loudspeaker. Many of the prior art stereo broadcasting proposals, such as the A hyphen B type proposals, failed to provide this compatability and in such prior art systems the monophonic listener would hear a lopsided program consisting of either the A program material alone or the B program material alone. (R. 221-2; 269-72; 334; PX-22).

(b) *Balanced Noise*—The Crosby system provides the desirable feature that the signal-to-noise level at both of the receiver loudspeakers is the same. It is inherent in stereo transmission and reception that one of the transmission channels is noisier than the other. This difference in noise level is undesirable and distracting when the more noisy channel is reproduced through one speaker and the less noisy channel is reproduced through the other, as in certain of the prior art proposals. The Crosby system overcame this problem by balancing the noise level so that an equal amount of noise is reproduced from both stereo loudspeakers thus eliminating this undesirable and disturbing imbalance in noise (R. 232; 303; 643; 770-1).

(c) *High Fidelity*—The Crosby system provides for high fidelity transmission and reception so that the listener may, within his hearing capabilities, receive full frequency range without cut-offs at the low or high end. This provision of full frequency range is recognized as a very desirable performance characteristic as it gives the listener the undistorted high fidelity benefits he would receive were he present at a "live" program in the broadcast studio. It thus provides a more complete and more aesthetically desirable entertainment medium. The desirability of such high fidelity stereo is manifested by defendant's advertising brochures (PX-49 and 61 through 65).

(d) *Full Separation*—The Crosby system provides for full stereo separation (that is, separation throughout the audible frequency range) between the two receiver loudspeakers. This means that none of the A program information is put out by the B loudspeaker and none of the B program information is put out by the A loudspeaker.

Many of the prior art experimenters failed to provide the complete separation characteristic that is required. Many of them failed even to recognize the importance of this separation characteristic. Indeed, in 1958, the year Mr. Crosby's patent issued, defendant undertook an investigation to determine the importance of full frequency separation in order to obtain a stereophonic effect (R. 1936-51). One of defendant's witnesses, Mr. Moore, took part in that experimental determination and in April 1960 published a paper (PX-40) having the title "Perception Of The Stereophonic Effect As A Function Of Frequency". He and his co-author concluded:

> "Therefore, good stereophonic sound systems would seem to require reproduction of the stereophonic effect over the entire audible band." (PX-40 at p. 84)

Defendant then took the position before the FCC [2] that full frequency separation was required. (PX-37 at p. 4). In doing so they opposed a widely accepted misconception shared by many in the industry including such reputable people as The Radio Corporation of America (RCA) who as late as 1960 recommended a subchannel modulation band from 30 to 9,500 cycles which is substantially less than full audio frequency. (PX-37 at p. 3). This lack of separation of the full audible frequency range was one of the major points made by the FCC in rejecting certain other proposed systems (PX-37 at p. 2-3; R. 732). In its "Report and Order" the FCC said of these rejected proposals:

> "Hence, the systems lack stereo separation above the stereo subcarrier cut-off frequency. There is considerable evidence that frequency response and stereo separation above 8,000 cycles make a significant contribution to stereophonic quality." (PX-37 at p. 3).

Thus, after much testing and experimentation, carried out after the Crosby teachings were known, defendant came to the conclusion that Mr. Crosby was right and defendant, in another forum, argued to the effect that systems and proposals which did not accord with Mr. Crosby's teachings ought to be rejected.

(e) *Bandwidth*—The Crosby system achieves all of the foregoing results within the bandwidth rules of the FCC so that a stereo system was provided which did not require an increase in the frequency band allocated to an FM broadcast station. Radio transmission requires separate

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[2] Technically this position and the proposals referred to in later Sections were addressed to the NSRC, a committee organized within the industry to make recommendations to the FCC with the official blessings of this government agency (PX-34).

bandwidths or roadways through the air. The metes and bounds of these bandwidths are carefully regulated by the FCC to avoid interstation interference. Mr. Crosby supplied a system which could transmit from a single station a stereophonic program having all the desirable attributes of Finding 17(a) through (d), above, and which would also fall within the allotted FM bandwidths designated by the FCC.

18. No system known prior to Mr. Crosby's teaching provides the combination of performance characteristics listed in Finding 17.

19. No prior art experimenter had either faced up to or provided a solution to all of the problems inherent in attaining the above performance characteristics, owing either to a lack of understanding of the existence of one or more of these problems or to an inability to solve them. Not only was there no radio apparatus in existence, prior to Mr. Crosby's invention which had the essential combination taught by him (set forth in Finding 13), but, perhaps equally significant, no radio equipment existed prior to his invention which provided the foregoing desired performance characteristics set forth in Finding 17. Thus not only did Mr. Crosby teach a novel and non-obvious structure or system, but he provided a radio system that has performance characteristics which are a pronounced improvement over anything previously known.

The Prior Art

German Patent No. 861,884 to Griese (DX-A, tab 7)

20. This German patent to Griese applied for in 1950 and issued in 1953, relates to a system for broadcasting FM stereo, by means of what has been called an "A hyphen

B'' system (R. 1794-5). That is, Griese involves a transmission of the A (or left) signal as a modulation on the main carrier and the B (or right) signal as a modulation of a subcarrier, which subcarrier is then modulated in turn onto the main carrier.

21. The Patent Office Examiner had before him knowledge that the " hyphen B'' system was part of the prior art by virtue of the disclosure of such as prior art in the second paragraph of the Crosby patent application as filed (DX-B).

22. Griese fails to consider or teach anything concerning the requirements of a transmission that would be compatible with reception by a monaural receiver (PX-22 R. 1207). To the extent that the Griese patent does discuss monaural reception (page 3 of the translation), the Griese teachings are incorrect and misleading. It is stated there that "the reception for the listener having a radio without a stereophonic attachment is in no way impaired by the stereophonic transmission.'' This is incorrect because the A (or left) signal that would be picked up by a monaural receiver would be an unbalanced signal (PX-22).

23. The Griese patent neither teaches nor suggests how to balance noise between the left and right speakers and a device constructed in accordance with this patent would result in unbalanced noise reception which is unsatisfactory (R. 232, 303, 643).

24. The Griese patent fails to explicitly teach the use of full audio frequency on both the main and sub-carrier channels.

25. Even if it be conceded that Griese implies the use of full frequency on both channels, such teaching with relation

to an A hyphen B system is in no way suggested as relevant to a matrixing, that is (A + B) and (A — B), system.

26. At most, the Griese patent suggests that the A signal on the main channel and the separate B signal on the sub-channel could be transmitted at the same full frequency. But in matrixing, or (A + B) and (A — B), system one of these signals, namely the (A + B) signal which is being transmitted on the main channel, contains a full frequency A signal and a full frequency B signal. Thus, this one signal on one channel contains the full frequency A and B signals. However, these A and B signals are mixed—they are not separate as in the Griese system—and the crucial problem confronting the art in 1953 was one of separation at all frequencies (PX-37; PX-40; R. 732; 2414).

27. The record shows that many skilled men in this art, such as representatives from RCA, Calbest and Multiplex, failed to appreciate the need for a full frequency (A — B) signal and advocated less than a full (A — B) frequency and that this error or misconception was the basis on which the FCC rejected two system out of the last five finalists before it (PX-37, p. 2-3; R. 732).

28. This most significant requirement for full frequency on the (A + B) and (A — B) channels to assure full frequency separation (and hence a full frequency A signal without any B mixed in reproduced from one loudspeaker and a full frequency B signal without any A mixed in reproduced from the other loudspeaker) is not a problem in the A hyphen B system of Griese. Without the problem, the solution is neither taught nor suggested.

29. There is no evidence that Griese or the owners of the Griese patent had ever built or operated a system in accordance with the teachings of the Griese patent.

Findings of Fact and Conclusions of Law

30. The German patent to Griese did not disclose the system of stereo broadcasting and reception set forth in Finding 13.

British Patent No. 540,185 (DX-A tab 1)

31. The British 540,185 patent is based on a French patent No. 860,672 (DX-A, tab 2) which was filed in France on June 30, 1939. The British patent issued on October 8, 1941.

32. The British 540,185 patent relates to matrixing (that is, sum and difference) to provide stereo transmission in standard narrow channel AM broadcasting. There is no indication in the British patent of the apparatus that would be required for FM transmission.

33. The matrixing teachings of the British 540,185 patent were before the Patent Office by virtue of the United States Patent No. 2,698,379 to Boelens (DX-A, tab 3). The Boelens patent issued during the prosecution of the Crosby patent application and was brought to the examiner's attention by Mr. Crosby (DX-B).

34. The teachings of the Boelens patent are as pertinent and are more comprehensive than the teachings of the British 540,185 patent (R. 1914-5; 2336-8). Defendant's assertions that improper representations with respect to the Boelens patent were made to the Patent Office by Crosby's attorney during the prosecution of the application for the patent in suit have no basis in fact (DX-B, pp. 71-4).

35. The British patent teaches matrixing (that is, the use of the sum and difference technique) for the purpose of providing compatibility in the context of AM broadcasting.

Findings of Fact and Conclusions of Law

36. The British patent teaches a technique of transmitting two audio signals over a single broadcast channel, which technique has been called by Mr. Crosby "modulation on modulation" and elsewhere "type" or "hybrid" multiplexing (R. 1326-32).

37. The employment of the modulation on modulation technique of transmitting two signals over a single broadcast channel results in a substantial decrease in the available bandwidth for the transmission of the information signal (R. 1520; 1532).

38. As a consequence, the fidelity (range of frequency of the audio signal that can be transmitted) is decreased by use of the modulation on modulation technique taught by the British patent (R. 1532).

39. Thus, the British patent fails to provide or teach a high fidelity system.

40. The British patent does not state or suggest anything concerning the desirability or advisability of employing superaudible subcarrier multiplexing to provide stereo radio transmission and in particular to provide such radio transmissions in connection with FM broadcasting. Rather, it teaches the use of a so-called "type" or "hybrid" form of channel separation which defendant admits would be undesirable from the standpoint of cross-talk (DX-T; R. 1892; 1906-7).

41. The British patent does not disclose any appreciation of the advantages or utility of using FM broadcasting for stereo. Indeed, as the first paragraph of the corresponding French parent patent indicates, this British pat-

ent is specifically geared and designed for use in AM broadcasting (DX-A, tab 2).

42. The British patent does not suggest or indicate what, if any, of the considerations that are pertinent in devising a stereo system for an AM broadcast channel would be helpful, useful or pertinent in designing a stereo system for an FM broadcasting channel.

43. The British patent does not consider or teach anything concerning the problems of high fidelity transmission, that is, transmission over substantially the full audio frequency range.

44. The British patent fails to state or suggest anything concerning the relationship between the frequency range transmitted over the two channels and the extent of stereo separation.

45. A significant shortcoming of this British patent is its confusing teachings as regards the bandwidth transmitted by its modulation on modulation techniques. This teaching served to confuse and mislead defendant's expert, Mr. Bose, as shown by his inconsistent testimony on this point on direct and cross-examination (R. 1120; 1143-5; 1516-22).

46. There is no evidence that Standard Telephones and Cables Ltd. or anyone associated with them had ever built or operated a system in accordance with the teachings of the British 540,185 patent.

47. The British 540,185 patent did not disclose the system of stereo broadcasting and reception set forth in Finding 13.

German Patent No. 819,548 to Egerer (DX-A, tab 9)

48. This German patent to Egerer applied for in 1949 and issued in 1951 relates to a technique for transmitting stereophonic information by means of a square or rectangular wave switching technique (R. 2267-9).

49. The Egerer patent has neither drawings nor a description of specific circuitry and was properly characterized on the Record as a theoretical discussion (R. 2267-8).

50. Egerer suggests the use of a square wave switching technique for switching from the transmission of the A (or left) signal to the B (or right) signal to the A signal and so on, back and forth, at a rate more rapid than the human ear can hear. The Egerer approach is known in the art as a sampling or time division approach (R. 2269-70; 2278-9).

51. Egerer does not discuss or suggest the matrixing or dematrixing of the two stereophonic signals A and B. Egerer does not teach or suggest the transmission or reception of a sum signal (A + B) or of a difference signal (A — B) (R. 16651; 2273).

52. Neither sum and difference nor any equivalent thereof is inherent in the Egerer teachings (R. 2273-4).

53. The only aspect of Egerer which even approaches sum and difference is the creation by its square wave switching technique of an (A + B) signal and a great many (A — B) sidebands and even this wasn't recognized until long after the Crosby invention (R. 1753-4; 2162-3).

54. Rectangular or square wave switching, the only kind of switching contemplated by Egerer, does not provide

matrixing that would produce an (A + B) signal and an (A — B) signal as taught by Mr. Crosby (R. 1733-61).

55. Square wave switching does provide a rectangular signal that has a large number of (A — B) signals disposed over a broad frequency spectrum. For this reason, the Egerer approach requires an enormous bandwidth for the transmission of all the harmonics of the switching rate frequency (R. 2275).

56. Consequently, following the Egerer approach would result in drastically reducing the number of FM stations that could be fitted into the spectrum allocated for FM broadcasting (R. 2275).

57. If the Egerer generated spectrum of frequencies were to be filtered to provide a signal that would fit within an allocated FM channel, then only a segment of the (A — B) information would be transmitted to the receiver with a consequent mixture of, or lack of separation between, the A and B signals at the speakers (R. 2272-3; 2276).

58. Thus, Egerer specifically teaches a form of switching that cannot be used within FCC bandwidth regulations and, of course, is not used (R. 2073-7).

59. The analysis of defendant's T-1000 series of receivers requires use of matrixing arithmetic (R. 2032-3). Thus, the Egerer switching technique has no relevance to the T-1000 series of receivers or to the matrixing technique which was taught and illustrated in Mr. Crosby's patent.

60. Recognizing that there are no square or rectangular waves employed in the T-1005 receivers (R. 2038-9) then, from one analytical point of view, the defendant's T-1005

receivers can be analyzed, if the appropriate simplifications are made, on the assumption that the receiver operates on a sine wave switching principle to accomplish the dematrixing of the (A + B) and (A — B) signals into separate A and B signals at the loudspeaker (PX-73; R. 2036-9; 2042-3).

61. However, sine wave switching is not taught or suggested by the Engerer patent nor is sine wave switching inherent in the operation of any device constructed in accordance with the Egerer teaching (R. 1733-6).

62. From another point of view, the defendant's T-1005 receivers can be analyzed as using a dematrixing approach to accomplish the dematrixing of the (A + B) and (A — B) signals into separate A and B signals at the loudspeakers (R. 2295-2301).

63. The comparison of the operation of defendant's T-1005 receivers and defendant's T-1000 receivers by defendant's witness, Mr. Moore, and by plaintiff's witness, Mr. Feldman, required the employment of matrixing mathematics (PX-71; R. 2032, 2039, 2299-2301).

64. The sine wave switching technique of analyzing the operation of the T-1005 receivers and the matrixing mathematics technique of analyzing the operation of the T-1000 receivers are equivalent.

65. Sine wave switching and square wave switching do not produce the same result and are not equivalent means for achieving a result.

66. There is no evidence that Egerer or the owners of the Egerer patent had ever built or operated a system in accordance with the teachings of the Egerer patent.

Findings of Fact and Conclusions of Law

67. The German patent to Egerer did not disclose the system of stereo broadcasting and reception set forth in Finding 13.

Summary—Comparison of Prior Art and the Crosby Invention

68. No item of prior art discloses the system combination taught and disclosed in the Crosby 2,851,532 patent.

69. No item of prior are discloses a system which has the performance characteristics of a system designed in accordance with the teachings of the Crosby 2,851,532 patent.

70. The differences between the subject matter of the Crosby patent and the prior art presented by defendant are substantial and are of such a nature that it would not have been obvious to a man skilled in this art having knowledge of this prior art to invent the FM stereo broadcasting system described and claimed in the Crosby 2,851,532 patent.

71. The German Patent No. 861,884 to Griese and the British Patent No. 540,185 to Standard Telephones and Cables, Ltd. when read together failed to disclose the system arrangement taught and claimed in the Crosby 2,851,532 patent and set forth in Finding 13.

72. The subject matter patented in the Crosby 2,851,532 patent when compared with the German Patent No. 861,884 to Griese and the British Patent No. 540,185 to Standard Telephones and Cables, Ltd. taken together, is such that the subject matter of the Crosby 2,851,532 patent would

not have been obvious to a person having ordinary skill in the art of stereo radio broadcasting systems.

73. The German Patent No. 819,548 to Egerer does not provide teachings which anticipate the invention described and claimed in the Crosby 2,851,532 patent.

74. More specifically, the FM stereo system described in the German patent to Egerer, with is square wave switching technique of multiplexing, fails to anticipate the teachings or the claims of the Crosby 2,851,532 patent where those claims are understood to have whatever scope is necessary to be infringed by defendant's T-1005 series receivers as well as by defendant's T-1000 series receivers.

75. There is nothing in the teachings of the German patent to Egerer which would make the Crosby 2,851,532 invention obvious to one skilled in this art.

76. There is no evidence that the system disclosed in the German patent to Griese, or in the British patent to Standard Telephones, or in the German patent to Egerer have ever been constructed, or tested, or put into practice.

History

77. As early as 1924, a patent was issued to Doolittle (U.S. 1,513,973) which taught stereophonic broadcasting by the use of two separate and distinct radio channels (PX-77). That is, he taught that the A signal could be transmitted through one transmitter apparatus and the B signal through another separate transmitter apparatus and at the receiving end two separate receivers could be used to receive these separate signals on different chan-

nels or at different frequencies and be separately reproduced over two speakers or earphones. Doolittle also suggested that the A and B signals could be separately transmitted on two separate subcarriers which could be modulated onto a signal main carrier (R. 2329-30).

78. In 1937, a patent issued to Electric and Musical Industries, Limited (EMI) based on an application filed in 1932 which discussed the possible use of the sum and difference technique of transmitting two separate signals over a signal wire or a single transmission channel (DX-W). This sum and difference technique is used in FM stereo as taught in the patent in suit.

79. In 1933, the renowned Major Armstrong obtained a patent which taught the advantages of wide band FM radio transmission and reception (PX-25; R. 291-3). Such wide band FM radio transmission and reception is utilized in FM stereo as taught in the patent in suit. Such wide band FM broadcasting was approved on a commercial basis by the FCC in 1940.

80. While the scientist were providing this new FM broadcasting medium, the artist, Leopold Stowkowski, provided a demonstration to illustrate the effectiveness and realism of stereophonic transmission. In 1933, he used three microphones at the studio, three wires for transmission and three loud-speakers at the listening end to provide an audience in Constitution Hall in Washington, D.C., with a contemporaneous stereo reproduction of a concert taking place in Philadelphia (R. 290; PX-24).

81. At about the same time, Bell Telephone Laboratories demonstrated the effectiveness of true binaural

transmission over wires at the Chicago World Fair with their famous "Oscar" demonstration (R. 285-6). Subsequently, Bell illustrated the same thing in various demonstrations around the country (R. 286-7).

82. Thus, it may be seen that at least as early as 1933 the broadcast medium that would ultimately be used in FM stereo, namely wide band FM, had been invented and the sum and difference technique of transmitting separate signals on a single channel had been invented, and a desire for stereo with its more realistic reproduction of program material had been created. However, the Crosby invention which utilized the wide band FM medium and the sum and difference technique and made it possible to fulfill this desire on a practical commercial basis, did not come about until 1953 and not until 1961 did the FCC approve FM stereo broadcasting on a commercial scale (R. 132; PX-1 and 37). It was only then that the defendant started to produce and sell FM stereo receivers (R. 127).

83. During the period from 1933 to 1953, a number of people in the radio transmission and reception art in the United States and abroad were experimenting in an attempt to provide a practical solution to the transmission and reception of stereo signals. Some of this activity is reflected in many of the patents cited by defendant as listed in Finding 5.

84. One of the experimenters in this art was Major Armstrong who actually carried out a public demonstration in 1953 (PX-67) and who on the eve of the invention covered by the patent in suit told a reporter for The New

York Times of the desirability of stereo reported as follows:

> "Use of two channels to broadcast a concert * * * would permit placement of microphones at different points in a studio or hall and transmission of the sound from a number of points. With the use of two loudspeakers in a home the concert would have a toned quality similar to what one hears through both ears if actually attending a recital. Such binaural transmission up to now * * * has required use of either two FM stations or a combination of FM and AM." (PX-68; R. 1833-4)

85. The inventor of the invention covered by the patent in suit is Murray G. Crosby who has been involved with the technical aspects of the electronic communications field since 1925 (R. 276). For some 24 years (1929-1953) prior to making the invention covered by the patent in suit, he had actively specialized in experimentation in the FM communication field (R. 278). In this art he has authored 17 or 18 technical articles, many of which have appeared in technical publications and has had nearly 200 patents issued in his name (R. 254-7; PX-23, 29 and 30).

86. Mr. Crosby's invention, when he made it publicly known in 1953, was widely publicized (DX-S—trip report of G.E. personnel to Crosby Laboratories on August 13, 1958; R. 2164-5). The industry immediately appreciated that his system might constitute a significant advance and his laboratory became a mecca for the top technical people in this field. During the years 1954 and 1955 he gave at least 50 demonstrations of his system to such people at his laboratory including representatives from the defendant, as well

as from Sylvania; NBC and RCA (R. 319; 337-49; 2164; DX-S).

87. It is noteworthy that all of these major companies in this art maintained extensive research and development facilities well equipped to carry out experimentation in the stereo field.

88. Because of the nature of the industry and the requirements for FCC approval before any new broadcast system could be adopted, much time elapsed and had to elapse before the practice of his invention received formal legal sanction in 1961.

89. However, long before the formal legal recognition, his proposal received wide acclaim. As early as June 15, 1953, he presented a paper on his invention at the American Institute of Electrical Engineers mid-summer convention at Atlantic City, New Jersey, at which time Major Armstrong was one of the discussants of his paper (R. 314-6; PX-28 and 29). Subsequently, Mr. Crosby presented many papers and addresses on his invention throughout the United States and Canada up to the time his patent issued in 1958 and still more papers were presented through the year 1961 (R. 336-7; 2164).

90. This industry-wide recognition was reflected in more than a willingness to spend both money and valuable engineering time in listening to and studying his papers and viewing his demonstrations. Thirty (30) separate companies took licenses from Mr. Crosby for operation under his patent (R. 133).

91. The defendant did not evince an interest in FM stereo until 1957 and at that time their representatives at-

tended meetings where Mr. Crosby spoke on his system, attempted to obtain copies of his talks and met with him to obtain the details of his system (DX-I; DX-J).

92. In 1958, representatives from defendant visited Mr. Crosby's laboratory to view a demonstration and test a new G.E. radio receiver tuner with the Crosby system (DX-S). These representatives circulated a detailed report on the Crosby system to numerous people in research and development in G.E. (DX-S). Also, the defendant was furnished with a copy of Crosby's patent in suit at about the time it issued (DX-S).

93. The defendant did not begin to develop their stereo receiver circuitry design until 1959 (R. 2082-3; 2169).

94. As late as April, 1966, Mr. Crosby appeared on a radio panel with, among others, Mr. Kassens—Assistant Chief of Broadcasting Facilities of the Federal Communications Commission—and during a discussion of the stereo broadcasting proposals that were before the FCC, the moderator asked Mr. Kassens whether he had any historical data and he responded in part: "Only to compliment Murray Crosby. I think he did an amazing amount of work to get this thing down the right track." (PX-27). Defendant's expert, Mr. Bose, was also on this panel and when confronted, during the trial, with Mr. Kassens' opinion concerning Mr. Crosby's contribution, he stated that he had no reason to disagree (R. 1820).

95. In recognition of his contributions to this field, pursuant to a recommendation by the Institute of Electrical and Electronic Engineers, the latest annual Merwin J. Kelly Award set up by The Bell Telephone Laboratories was re-

cently conferred on him with the following citation: "For his pioneering work in the circuit technology, propagation characteristics and noise suppression theory of frequency and phase modulation." (R. 257-9).

96. The first broadcast of FM stereo using the Crosby system was in 1958 under a temporary authorization from the FCC (R. 330-1).

97. On July 8, 1958, the FCC issued a Notice of Inquiry for the purpose of exploring additional uses of FM multiplexing (DX-S; R. 131). Interested persons submitted comments in response to this Notice of Inquiry evidencing a broad interest in FM stereo broadcasting and the FCC responded by issuing a Notice of Proposed Rule Making on May 9, 1960 wherein some seven (7) FM stereo proposals, including two submitted by defendant and one submitted by Mr. Crosby, were evaluated (PX-34; R. 132).

98. After considering the proposals the FCC issued a Report and Order on April 20, 1961 which was effective as of June 1, 1961 authorizing FM stereo (PX-37; R. 132). In this Report and Order the FCC narrowed the proposals under consideration to the Crosby proposal and the so-called Zenith-General Electric proposal. The other systems were eliminated because they failed in one respect or another to provide a system having the characteristics set forth in Finding 17. The fundamental error that a number of the rejected proposers made was in submitting systems which incorporated the widely accepted misconception in the art that it was not necessary to provide for full frequency on the (A + B) *and* (A — B) channels (PX-37; PX-40; R. 732; 1944-5).

Findings of Fact and Conclusions of Law

99. The FCC adopted the system proposed by Zenith and General Electric, which system differed in details from the proposed Crosby systems.

100. The basic FM stereo system disclosed and claimed in the patent in suit was used in both the Crosby proposal and the Zenith-General Electric proposal (PX-37; R. 7-9).

101. Quite apart from, and in supplement to, the non-obviousness of Mr. Crosby's invention in light of the prior art presented by defendant, the history of the art both before and after Mr. Crosby's invention shows that:

(a) Mr. Crosby's invention fulfilled a long existing and unsolved need for stereo broadcasting. That stereo transmission could provide improved realism for the listener was demonstrated in the early 1930's through well publicized demonstrations by Leopold Stokowski and Bell Telephone Laboratories (R. 290; 285-7). That such a means of transmission would be of great benefit was recognized by Major Armstrong, a well-recognized authority in the FM radio art (PX-68).

(b) The elements that Mr. Crosby adapted to one another and brought together to constitute his invention were present in the art for a generation (since the early 1930's) before Mr. Crosby made his invention in 1953. In spite of a great deal of interest in stereo broadcasting during that 20 year period, no one arrived at a solution to all of the problems involved until Mr. Crosby combined these elements in his invention.

(c) About thirty (30) companies took a license under Mr. Crosby's patent in the period of time just prior to and after its issuance in 1958 (R. 133-4).

(d) The system adopted by the industry pursuant to an FCC order in the spring of 1961 follows the teachings of the patent in suit (R. 7-9).

(e) A number of highly skilled and respected inventors in this industry had turned their attention to the problem of providing a practical means for stereo broadcasting. During the time prior to the Crosby invention in 1953, as well as during the 6 to 7 years thereafter, none of these people succeeded (Findings 77-84; 87; 96-99).

102. Thus, it may be seen that Mr. Crosby's invention involves a wholly novel combination of elements which performs a function never before performed and which has profoundly influenced the development of the radio art.

103. In short, virtually every indicia of invention which has ever been looked to in order to bolster the presumption of validity and to lend a measure of objectivity to the concededly subjective determination of non-obviousness is found in the history of this art. These indicia serve to strengthen the significance of Mr. Crosby's invention and the validity of Mr. Crosby's patent.

Conclusions of Law

1. This Court has jurisdiction over the parties and over the subject matter. 28 U.S.C. § 1338.

2. The patent in suit, United States No. 2,851,532, issued September 9, 1958, including claims 10, 12, 16, 18, 22, 24 and 25 was legally issued and is a valid patent. 35 U.S.C. §§ 102, 103.

3. By virtue of defendant's stipulated waiver with respect to the issue of non-infringement, defendant has in-

fringed claims 10, 12, 16, 18, 22, 24 and 25 of the Crosby 2,851,532 patent by the manufacture, use and sale of, among other equipment, defendant's T-1000 series and T-1005 series of FM stereo receivers, MA-2F and MA-100 adapters and transmitter equipment at Station WGY in Schenectady, New York.

4. Plaintiff is entitled to an accounting of damages adequate to compensate for the infringement, but in no event less than a reasonable royalty, together with interest, as a result of defendant's manufacture, use and sale of infringing equipment from the date September 15, 1958, six years prior to the commencement of this infringement action. 35 U.S.C. §§ 284, 286.

5. Plaintiff is further entitled to an award of costs and, if the proof before the master warrants, to an award of attorneys' fees. 35 U.S.C. §§284, 285.

6. There is insufficient proof in the record thus far to sustain plaintiff's claim for treble damages. The plaintiff may, however, submit any relevant proof to the master to be appointed. 35 U.S.C. §§ 284.

7. In view of the representations made by Crosby Teletronics Corp. to the Federal Communications Commission (FCC) in connection with the submission of its proposal, plaintiff is not entitled to an injunction restraining the defendant from further infringing the patent in suit.